PB-237 898-T

PHYTODERMATOSES CAUSES BY CYANOPHYTA AND ALGAE

J. Krauskopf

Environmental Protection Agency
Research Triangle Park, North Carolina

October 1974

DISTRIBUTED BY:

NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE

312017

EPA-TR 29 - 75

PB 237 898-T

PHYTODERMATOSES CAUSED BY CYANOPHYTA AND ALGAE
[Fytodermatozy zpusobene sinicemi a rasami]

by

J. Krauskopf
Dermatological and Venereal Clinic at the Institute for Continued Education of Physicians and Pharmacists, Prague, Director A. Fadrhoncova, M.D., Cand. Sc.

Published in Ceskoslovenska Dermatologie, Vol. 48, No. 3, June 1973, p. 195.

Myxophyceae and cyanophyta may be the cause of toxic or allergic contact dermatitis and like algae may cause atopic hypersensitivity. Algae (Phycophyta, Algophyta) cause often symptoms of atopic hypersensitivity after inhalation of the allergen. Cases of allergic contact dermatitis are more rare. Achloric algae of the genus Prototheca are also parasites of man in exceptional circumstances (protothecosis).

Phytodermatoses caused by blue-green algae and algae have so far not been treated systematically and the lists of "plants irritating the skin" usually do not include

---

Translated for NERC-Library, EPA, from the Czech by Leo Kanner Associates, P. O. Box 5187, Redwood City, CA 94063 (415) 365-3046, October 1974.

Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

12

blue algae and algae. Nevertheless familiarity with this problem is important not only in regions near the sea where the phytodermatoses are caused more frequently by them, but also in interior regions, since also here blue algae and algae can act as contact or inhaled allergens.

Blue algae (Myxophyceae, Cyanophyta) have the simplest body structure from among all plants in the autotrophic taxonomic groups. From the evolutionary standpoint, they are closest to bacteria (Bacteriophyta, Schizomycetes). The dermatoses caused by blue algae include toxic and allergic contact dermatitis or symptoms of atopic hypersensitivity similar to that of algae.

Algae (Phycophyta, Algae, Algophyta) are single-cell and multi-cell organisms of various sizes, whose lengths reach several tens of meters. Algae cause usually atopic sensitivity which manifests itself by itching (sometimes with urticaria), at other times by an aggravation of the atopic dermatitis after contact, vasomotor rhinitis, or mild bronchial asthma after inhalation of the allergen. The diagnosis is confirmed by prick tests with aqueous extracts of algae (approximately 25 vol %) or intracutaneous test made using the usual technique. Allergic contact dermatitises are rarer than atopic hypersensitivity. The evidence are the positive patch tests with the algae in their native state. From some algae essential oils were obtained containing substances with

known allergenic effects.

In addition many hypotheses exists about other possible damage to the skin by algae. Thus, the ability to irritate mechanically the skin is attributed to shells of yellow algae whose composition is pure silicic acid or to certain green algae that inhabit water and moisten rice-fields. Acute papular dermatitises which occurs in certain areas after seabathing ("seabather's eruption") may also be connected with the occurrence of certain algae. The eruption, especially in areas covered by the trunks, is sometimes signalized by itching, already during the bathing. Algae particles that penetrate the skin are also discussed in the origin of nodular regions on the extremities among sport divers [Cerutti and Pisani, 6].

Demonstrated cases of parasites of man and animals (protothecosis) are rare.

Specialized Part

Genus. Myxophyceae (Cyanophyta) (blue algae, blue-green algae).

The genus Microcystis LEMMERMANN from the order Chroococcales and the family Chroococcaceae participates in the origin of the "water flower". It yields positive intracutaneous tests among persons in whom an atopic hypersensitivity to blue algae from the Oscillatoriacea family has been determined [Heise, 12].

For the dermatologist the most important are the two families from the order Hormogonales (Oscillatoriales). From the first family Nostocaceae, it is the genus Nostoc VAUCHER, which gives positive intracutaneous tests in some inhalation allergies [McElhenney and McGovern, 19] and the genuses Anabaena BORY and Aphanizomenon MORREN which contribute to the origin of the "water flower" in stagnant and slow flowing water together with the genus Microcystis from the Chroococcaceae family. The contribution of the "water flower" to the origin of difficult skin reations [15] and the aggravation of the atopic eczema according to our observations cannot be doubted. At the same time possibly the reproducing bacteria or the decomposition products from the blue algae can also play a role [Fott, verbal report]. Anabaena gives a weak positive prick test in some cases of atopic hypersensitivity [Champion, 14]. It can also cause allergic contact dermatitis in areas not covered by the trunks and at least one of the allergens is the blue pigment phycocyanin from the blue algae [Cohen and Reif, 7].

Symptoms of vasomotor rhinitis, conjuctivitis, bronchial asthma and urticarial eruptions caused by members of another family, the Oscillatoriacea, have been known after lake bathing [Heise, 11]. This can be demonstrated by intracutaneous tests and passive transference of antibodies. Specific desensitization is important

in therapy. The genus Lyngbya C.A. AGARDH from this family consists of about one hundred species inhabiting fresh and sea water. Among these L. majuscula GOMONT causes toxic dermatitis with the same clinical picture and course as superficial burns [dermatitis escharotica Grauer, "seaweed dermatitis", 9]. The symptoms which manifest themselves as an itch or burn, occur after several minutes or hours of sea bathing, depending on the length of stay in water. The localization occurs especially in areas covered by the bathing suit (scrotum, perineum and among women also the breast). Washing using soap and water up to one hour after the bathing is sufficient to prevent the dermatitis, washing after 1 - 3 hours makes the symptoms less acute. Toxic and nontoxic clones of L. majuscula exist. The toxin is non-volatile, easily soluble in methanol, chloroform, acetone, diethyl ether and ethanol, slightly soluble in petroleum ether and insoluble in water. Ultraviolet radiation reduces the toxicity and the toxin is inactivited by reduction or oxidation [Moikeha, Chu and Berger, 23].

In our country "water flowers" and their effect on the skin were studied by Stepanek, Binovec, Chalupa, Jirik, Schmidt and Zelinka [Collection of the Chemical Engineering School in Prague, 1963, Technologie vody, (Water Engineering), Vol. 7, No. 2].

Genus: Chromophyta

The most important class are the Bacillariophyceae (Diatomeae), yellow algae with about 170 genuses and 5,500 species. These are single-cell algae whose habitat is fresh and sea water. Their walls are highly incrustated with SiO_2. Cohen and Reif [7] think that their shells may irritate the skin.

From the genus Fragilaria LYNGBYE (family Fragilariaceae, suborder Araphidineae, order Pennales) F. striatula LYNGB. causes occupational eczemas during fishing and lobster catching. The discoid eczema lesions are localized especially on exposed parts of the body and after a relatively long time lead to dystrophy of the nails and loosening of the nail plates. The allergen can be extracted with ethyl alcohol, acetone and chloroform, however not with diethyl ether [Beer and Jones, 2]. Differentially, it is necessary to eliminate diagnostically the "Dogger Bank itch", and allergic contact dermatitis caused by Alcyonidium hirsutum (FLEMING) or A. gelotinosum (L.) which give positive patch tests with homogenates of these organisms which resemble plants [Newhouse, 24].

The class Phaeophyceae, brown a l g a e, are distinguished by an accumulation of iodine in the form of KI and NaI. Brown algae are found only in sea waters. The genus Laminaria LAMOUROUX (family Laminariaceae, order Laminariales, group Heterogeneratae) gives an indefinite

positive prick test in some cases of atopic hypersensitivity to pollen and algae [Champion, 14]. It contains a very small amount of essential oil which includes methylmercaptan, trimethylamine, acetone, propionaldehyde, formic to capric acid, palmitic acid, p-cresol, benzaldehyde, valeraldehyde, α-methylfurfural, furfural, α-pinen, d-limonene, geraniol, linalool, furfuryl alcohol, 1,8-cineol, eugenol and other substances [Katayama according to Hegnauer, 10]. The genus Fucus L., a seaweed (family Fucaceae, order Fucales, group Cyclosporae), gives an indefinite positive prick test in atopic hypersensitivity to pollen and algae [Champion, 14]. F. vesiculosus L., a bubbly seaweed and F. serratus L., whose habitat is the Atlantic ocean, the North and Baltic sea and the western part of the Mediterranean, have often beds overgrown with Alcynidium hirsutum (FLEMING) moss which may cause an allergic contact dermatitis known by the name "Dogger Bank itch".

In the class Dinophyceae two species are worth noting: The species Gymnodinium STEIN (family Gymnodiniaceae, subspecies Gymnodiniineae, order Peridiniales – paralyzers, dinoflagellata, subclass Dinophycidae) and the genus Polykrikos BUTSCHLI from the family Polikrikaceae (same taxons as in the family Gymnodiniaceae). The G. brevis DAVIS causing the "red tide" and the genus Polykrikos are cited in connection with the origin of "seabather's eruption"

or "marine dermatosis" [Hunter, Molloy and Ullman, 13].

Genus: Thodophyta — red algae

Red algae accumulate iodine in smaller amounts than brown algae. Some of them are incrustated with calcium carbonate, calcium sulphate, calcium phosphate and a few species also with calcium nitrate. The genus Porphyridium NAGELI (family Porphyridiaceae, order Bangiales, suborder Bangiophycidae) gives an indefinite positive prick test in atopic hypersensitivity to pollen and algae.

Genus: Chlorophyta, green algae

The most important class are Chlorophyceae, the green algae themselves. The genus Chlamydomonas EHRENBERG (family Chlamydomonadaceae, suborder Chlamydomonadineae, order Volvocales — green flagellata) which is common in fresh waters (rare in sea water) and in moist soil, can be the cause of atopic hypersensitivity [Champion, 14].

The order Chlorococcales, green cell (coccus) algae is very important.

From the family Chlorococcaceae two species from the genus Chlorococcum MENEGHINI may participate in the origin of respiratory allergies [Bernstein and Safferman, 4], the genus Neochloris STARR and Bracteacoccus TEREG (McElhenney, Bold, Brown Jr. and McGovern, 18]. The genuses Trebouxia PUYMALY and Myrmecia PRINTZ from the same family which are classified as phycobiont lichens

can also cause atopic hypersensitivity [Champion, 14]. The genus Coccomyxa SCHMIDLE (family Gloeocystidaceae) also a phycobiont lichen and the genus Chlorella BEIJERINCK (family Oocystaceae, subfamily Chlorelloideae) generally common in waters, moist areas, and in the soil are equally important.

The genus Prototheca KRUGER resembles an achloric mutant of the genus Chlorella. P. segbwema DAVIES, SPENCER et WAKELIN was described as the originator of the first known case of human protothecosis. The parasite was found in the epidermis, the outer skin and in the lymphatic node from the femoral lymphadenitis. The cause of other cases of human protothecosis was P. wickerhamii TUBAKI et SONEDA. The skin lesions on the head or the lower extremities begin as delicate papulae whose size is 1 - 2 mm and subsequently become pustules and carbuncles whose size is 2 - 5 mm or nodes whose size is approximately 1 cm which can ulcerate in the center. Under the thin epidermis an acute inflammatory or even chronic granulomatous reaction can be seen in the dermis. In the upper corium are countless giant cells containing in the cavities spherical eosinophilic corpusclescolored with various intensities. The organisms which resemble yeast fungi are not only in the giant cells, but also freely scattered in the skin tissue. A Leucoplasts with starchy grains

which are characteristic of Chlorophyceae can be demonstrated under an electronic microscope [Lee, 16]. The primary isolation of the parasite can be carried out on Sabouraud's agar at 25°C in a medium with dextrose and chloramphenicol. The smooth cream-colored colonies can be seen already after 48 hours. Cychloheximide inhibits their growth. Therapeutically Kalium iodatum proved itself [Mars, Rabson, Rippey and Ajello, 17].

From among the other families of the order Chlorococcales, the Ankistrodesmaceae are worthy of attention. Among these the genus Ankistrodesmus CORDA may be the cause of atopic hypersensitivity [Champion, 14] and Scenedesmaceae with genus Scenedesmus MEYEN. S. basilensis CHODAT may contribute to the origin of respiratory allergies [Bernstein and Safferman, 4].

Fibrous organizations of green algae form the order Ulotrichales. From the suborder Ulotrichineae the following genuses are important in the origin of atopic hypersensitivity: Stichococcus NAGELI and Hormidium KUTZING emend. KLEBS from the family Ulotrichaceae and the genus Ulva L. from the family Ulvaceae (U. lactuca L., "sea salad"). The suborder Chlorosarcinineae has the single family Chlorosarcinaceae. The genuses Chlorosarcina GERNECK (including Chlorosarcinopsis HERNDON) and Tetracystis BROWN et BOLD may contribute to the origin of res-

piratory allergies [McElhenney, Bold, Brown Jr. and McGovern, 18 and McGovern, Haywood and McElhenney, 20].

In the class Conjugatophyceae, conjugate algae, the genus Mesotaenium NAGELI (family Mesotaeniaceae, order Mesotaeniales, Champion, 14) may cause atopic hypersensitivity.

Charophyceae, green algae, grow in stagnant or slowly flowing fresh water and are easily incrustated with $CaCO_3$. From the family Characeae the genuses Nitella AGARDH (subfamily Nitelloideae) and Chara L. (subfamily Charoideae) inhabit waters which irrigate ricefields, and mechanical irritation of the skin of the hands and the lower extremities in fields is attributed to them [Behl, Captain, Bedi and Gupta, 3]. However it was not possible to induce experimentally dermatitis with the species Ch. vulgaris VAIL. and one of its forms f. kieneri (DAILY) NORTON ex R.D.W. [Racc and Lengyel, 25].

In conclusion it is my pleasant duty to extend my thanks to Prof. Bohuslav Fottov, RNDr., DrSc., for his kind help and advice.